WORK IT OUT

A maths workbook — concepts, worked examples, graded practice and number puzzles

Do the Learn First pages before the practice. Do the practice before the puzzles. Full solutions are at the back — but they only help you after you have tried.

Part	What it is	How to use it	Time
1	Learn First	Read and annotate. Copy every worked example by hand.	25 min
2	Worked Examples	Cover the solution. Try. Then compare line by line.	20 min
3	Guided Practice	Steps are given; you fill the gaps.	15 min
4	Practice Set A · Fluency	Straight application. Aim for speed and accuracy.	20 min
5	Practice Set B · Reasoning	Multi-step. Show every line.	25 min
6	Practice Set C · Challenge	Stretch problems. One may beat you — that is fine.	25 min
7	The Crossnumber	Answers are numbers. Wrong maths will not fit.	20 min
8	Number Search & Magic Square	Solo or pairs.	15 min
9	Spot the Mistake	Audit a worked solution. Find the planted error.	15 min
10	Quick-Fire Round	Matching, True/False, Two Truths and a Lie.	15 min
11	The Escape Challenge	Teams of 4.	25 min

Part 1 · Learn First

Take any three consecutive square numbers — say 1, 4, 9. Add the smallest and largest: $1+9=10$. Subtract twice the middle one: $10-8=2$. Try 9, 16, 25: $(9+25)-2(16) = 34-32=2$. Try 25, 36, 49: $(25+49)-2(36)=74-72=2$. Every single time, the answer is 2. These pages show you exactly why — and hand you eight identities powerful enough to square 3-digit numbers in your head.

(a + b)² and (a − b)² — built from a square

Take two line segments of lengths a and b and build a square of side $(a+b)$. Split it into two smaller squares (areas a^2 and b^2) and two equal rectangles (area ab each). Together they tile the whole square, so:

¿

This is not a coincidence of shapes. Multiply it out with the distributive law and the same identity falls out for *any* real numbers, including negatives — try $a=-2, b=-3$: ¿ and $a^2+2ab+b^2=4+12+9=25$. It holds for fractions too.

Replacing b by $-b$ turns the plus into a minus everywhere the sign of b appears once, and leaves it unchanged where b is squared:

¿

Identity vs equation. $x^2-1=24$ is true only for $x=\pm5$ — that is an *equation*. ¿ is true for **every** x and y — that makes it an *identity*.

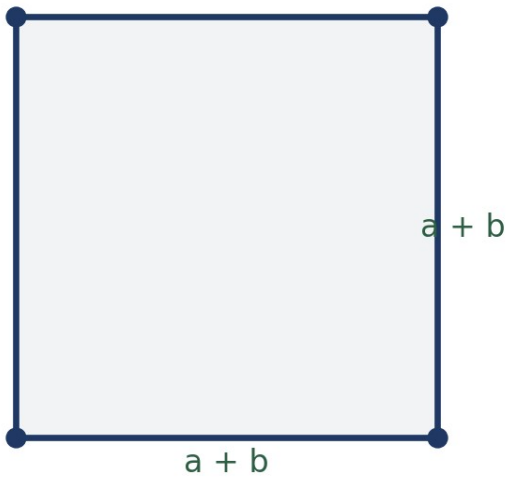


Fig. 4.1 — a square of side (a+b) splits into a², 2ab and b²

Rule to remember

- ¿
- ¿
- The **only** difference between the two is the sign of the middle term. The

squared terms are always positive.

- ¿ unless $ab=0$ — the missing middle term is exactly $2ab$.

Fast squaring with (a ± b)²

Find 43^2. Write $43=40+3$.

$43^2=$¿.

Find 29^2. Write $29=30-1$.

$29^2=$¿.

The trick: always split near the nearest multiple of 10 (or 100) so one term becomes a one-digit number.

(a − b)² geometrically, and the three-consecutive-squares proof

Split a square of side a into a piece of length $(a-b)$ and a piece of length b. Subtracting the two rectangles from the big square gives the same identity from the other direction:

¿

Now the opening puzzle, solved. Any three consecutive numbers are $(n-1), n, (n+1)$. Their squares are ¿. Add the outer two:

¿

Subtract twice the middle square, $2n^2$, and the n-dependent part cancels completely, leaving **2** — always, for any n. That is why the answer never changed.

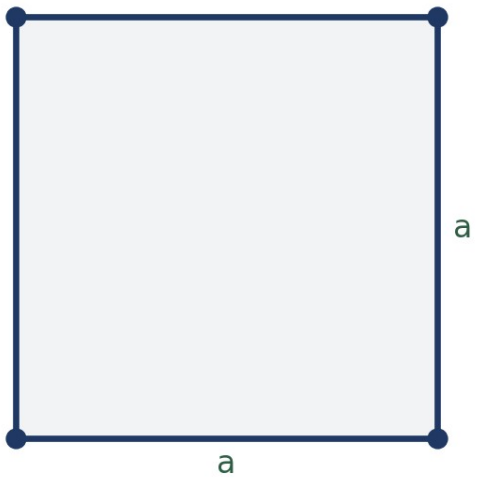


Fig. 4.3 — a square of side a split into (a−b) and b

Applying $a^2-b^2=(a+b)(a-b)$, rewritten as $a^{2}=(a+b)(a-b)+b^{2}$

This 750 CE identity (Śhrīdharāchārya) squares numbers near a round value.

Find 55^2**.** Move 5 up and 5 down: $55^2=(55+5)(55-5)+5^2$.

¿$60\times50+25=3000+25=3025$.

Find 18×29**.** These are not equal — use difference of squares directly where it applies, or expand normally when it does not.

The three-variable identity: (a + b + c)²

Replace b by $(b+c)$ inside ¿:

¿

Every pair of terms contributes one square and every **pair** of different letters contributes one doubled cross-term — three squares, three cross-terms.

Three identities so far

- ¿
- ¿
- ¿

Squaring a 3-digit number by splitting into hundreds, tens, units

Find 119^2**.** Write $119=100+10+9$.

$119^2=100^2+10^2+9^2+2(100)(10)+2(100)(9)+2(10)(9)$

¿$10000+100+81+2000+1800+180=14161$.

Why this beats long multiplication: every term is a square or a product with a round number — no carrying needed.

Factorising with (a ± b)² — matching the pattern

To factor x^2+4x+4: notice $x^2=¿$, $4=2^2$, and $4x=2(2)(x)$. Comparing with $a^2+2ab+b^2$ gives $a=x, b=2$, so:

$$x^2+4x+4=¿$$

For $36x^2+12x+1$: write it as ¿.

When a common factor hides the pattern, take it out first.
$50p^2+60pq+18q^2=2(25p^2+30pq+9q^2)=2¿$.

Spotting a perfect-square trinomial

- Check the first and last terms are perfect squares: x^2 and b^2.
- Check the middle term equals **twice** the product of their square roots.
- If the middle sign is $+¿$, use ¿; if $-¿$, use ¿.

Factorising the a²−2ab+b² way

Factor $16y^2-24y+9$**.** $16y^2=¿$, $9=3^2$, and $24y=2(4y)(3)$.

This matches $a^2-2ab+b^2$ with $a=4y, b=3$.

Answer: $16y^2-24y+9=¿$.

(x + a)(x + b) — algebra tiles and splitting the middle term

A rectangle of sides $(x+3)$ and $(x+4)$ has area $(x+3)(x+4)$. By distributivity, $(x+3)(x+4)=x^2+3x+4x+12=x^2+7x+12$ — the $7x$ splits as $3x+4x$, matching the tile picture exactly.

$$(x+a)(x+b)=x^2+(a+b)x+ab$$

Factorising is running this backwards. Given $x^2+11x+30$, find a, b with $a+b=11$ and $ab=30$. Trying factor pairs of 30 (1×30, 2×15, 3×10, 5×6) — only $5+6=11$ works. So $x^2+11x+30=(x+5)(x+6)$.

Negative middle term: for x^2-5x+6, need $a+b=-5, ab=6$. Both factors must be negative: $a=-2, b=-3$, giving $(x-2)(x-3)$.

Splitting the middle term — checklist

- Sum of the two numbers = coefficient of x.
- Product of the two numbers = constant term.
- Both negative if sum is negative and product is positive.
- One positive, one negative if the product itself is negative.

Factorising by splitting the middle term

Factor x^2-5x+6.

Need two numbers with sum -5 and product 6: they are -2 and -3.

$x^2-5x+6=x^2-2x-3x+6=x(x-2)-3(x-2)=(x-2)(x-3)$.

New identities: (a ± b)³, and the sum/difference of cubes

A cube of edge $(a+b)$ splits into two small cubes (volumes a^3, b^3) and six cuboids — three of $a \times a \times b$ and three of $a \times b \times b$, giving $3a^2b+3ab^2$ altogether:

¿

Replacing b by $-b$ makes the terms alternate in sign:

¿

Multiplying out two more products by the distributive law gives the sum and difference of cubes:

$$(x-y)(x^2+xy+y^2)=x^3-y^3$$

$$(x+y)(x^2-xy+y^2)=x^3+y^3$$

The full identity set for this chapter

- ¿
- ¿
- ¿
- $a^2-b^2=(a+b)(a-b)$
- $(x+a)(x+b)=x^2+(a+b)x+ab$
- ¿
- ¿
- $x^3-y^3=(x-y)(x^2+xy+y^2)$
- $x^3+y^3=(x+y)(x^2-xy+y^2)$

Reading off the cube root of a binomial expansion

What is the side of a cube of volume $p^3+6p^2q+12pq^2+8q^3$?

Rewrite: ¿ matches $a^3+3a^2b+3ab^2+b^3$ with $a=p, b=2q$.

Answer: the side is $(p+2q)$ units.

Second example: $8n^3-60n^2m+150nm^2-125m^3=$¿.

Part 2 · Worked Examples

Cover the right-hand column with a sheet of paper. Try the problem yourself first. Then uncover it one line at a time and check where your reasoning parted from the model.

Example 1 — Expand ¿ using ¿

Step 1. Match $a=5x, b=2y$.

Step 2. ¿

Step 3. ¿ $25x^2+20xy+4y^2$

Answer: $25x^2+20xy+4y^2$

> **Why this works**
>
> Squaring a binomial with coefficients is no different from squaring $(a+b)$ — just carry the coefficients through every term, including inside the squares.

Example 2 — Factor $10x^2-11x-6$ by splitting the middle term

Step 1. We need two numbers with sum -11 and product $10\times(-6)=-60$.

Step 2. Test factor pairs of 60: 4 and 15 give $4-15=-11$ with signs $4, -15$.

Step 3. $10x^2+4x-15x-6=2x(5x+2)-3(5x+2)$

Step 4. ¿ $(5x+2)(2x-3)$

Answer: $(2x-3)(5x+2)$

> **Why this works**
>
> When the coefficient of x^2 is not 1, the two numbers must multiply to (coefficient of x^2) × (constant), not just the constant — a common slip.

Example 3 — Evaluate 105^2 using a suitable identity

Step 1. Write $105=100+5$.

Step 2. Apply ¿ with $a=100, b=5$.

Step 3. $100^2+2(100)(5)+5^2=10000+1000+25$

Answer: 11025

> **Why this works**
>
> Choosing $a=100$ makes every multiplication trivial — always split so one part is a round number.

Example 4 — Factor $9a^2+4b^2+c^2-12ab+6ac-4bc$ using ¿

Step 1. Identify the three square roots: $\sqrt{9a^2}=3a, \sqrt{4b^2}=2b, \sqrt{c^2}=c$.

Step 2. Check the cross terms against $2(3a)(2b)=12ab$, $2(3a)(c)=6ac$, $2(2b)(c)=4bc$ and match signs: $-12ab$ (so $3a,-2b$), $+6ac$ (so $3a,+c$), $-4bc$ (so $-2b,+c$).

Step 3. So the three terms are $3a,-2b,c$.

Answer: ¿

> **□ Why this works**
>
> With three variables, get every sign right by checking all three cross-terms — one wrong sign among the three and the trinomial will not match.

Part 3 · Guided Practice

The method is laid out for you. Fill in the blanks. If you can do these without looking back at Part 2, you are ready for Part 4.

1. Expand ¿ using ¿.

Here $a=$¿ _____ and $b=$¿ _____.

¿

Final answer: $9x^2+$¿ _____ $x+$¿ _____

---

2. Find 204^2 using ¿.

Write $204=200+$¿¿.

$200^2+2(200)$¿

¿$40000+$¿$+16=$¿ _____

---

3. Factor $x^2+9x+20$ by splitting the middle term.

Find two numbers with sum 9 and product ¿¿.

They are _____ and _____.

$x^2+9x+20=x^2+$¿$x+$¿$x+20=$¿

---

4. Find the side of the cube whose volume is $x^3+9x^2+27x+27$.

Compare with $a^3+3a^2b+3ab^2+b^3$: here $a=x$ and $3a^2b=9x^2$ gives $b=$¿ _____.

Check: $3ab^2=3(x)$¿ _____ and $b^3=$¿ _____.

Final answer: the side is _____

Practice Set A · Fluency

Straight application of the method. Aim to get every one right, then aim to get them right quickly.

#	Question	Your working and answer
1	Expand ¿ using ¿.	
2	Expand ¿.	
3	Find 64^2 using a suitable identity.	
4	Find 79^2 using ¿.	
5	Factor $9x^2+24xy+16y^2$.	
6	Factor $4s^2+20st+25t^2$.	
7	Expand $(x+9)(x+2)$.	
8	Factor $x^2+7x+12$ by splitting the middle term.	
9	Find 41^2 using a suitable identity.	
10	Factor $16y^2-24y+9$.	

Practice Set B · Reasoning

Two or more steps, or a step you have to choose for yourself. Show every line — marks live in the working.

#	Question	Your working and answer
1	Find 198^2 using a suitable identity — state which identity you used and why.	
2	Factor completely: $\frac{9}{5}s^2+6sv+5v^2$.	
3	Expand ¿ using ¿.	
4	Factor $9s^2/4+6st+4t^2$ (write as $\frac{9}{4}s^2+6st+4t^2$).	
5	Fill in the blanks: $10x^2-11x-6=$¿.	
6	Evaluate (23×17) using a suitable identity.	
7	Factor r^2-r-42.	
8	What is the side of the cube whose volume is $8n^3-60n^2m+150nm^2-125m^3$?	

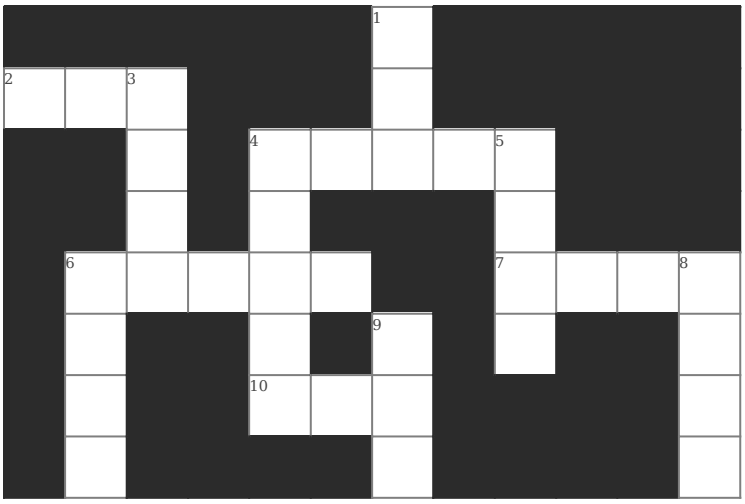
Practice Set C · Challenge

Harder, and deliberately so. If one defeats you, write down exactly where you got stuck. That sentence is worth more than a copied answer.

#	Question	Your working and answer
1	Is ¿ an identity? Prove or disprove.	
2	Factor $64\,u^{2}+121\,v^{2}+4\,w^{2}-176\,u\,v-32\,u\,w+$ using ¿.	
3	James says ¿. Reshma says ¿. Show both approaches give the same final expansion.	
4	Using $x^{3}-y^{3}=(x-y)(x^{2}+x\,y+y^{2})$, factor $27\,p^{3}-8\,q^{3}$.	
5	A cube has volume $p^{3}+6\,p^{2}\,q+12\,p\,q^{2}+8\,q^{3}$ cubic units. Find its edge, then find its total surface area in terms of p and q.	

Part 7 · The Crossnumber

Every answer is a number. One digit per square. Because answers cross, a wrong calculation simply will not fit — this puzzle marks itself.



ACROSS

2. 29^2 *(3 digits)*

4. 119^2 *(5 digits)*

6. 198^2 *(5 digits)*

7. 79^2 *(4 digits)*

10. 18×29 *(3 digits)*

DOWN

1. 23×17 *(3 digits)*

3. 43^2 *(4 digits)*

4. 105^2 *(5 digits)*

5. 34×43 *(4 digits)*

6. 55^2 *(4 digits)*

8. 41^2 *(4 digits)*

9. 27^2 *(3 digits)*

Part 8 · Number Search & Magic Square

Work out each answer, then find it hidden in the digit grid — across, down, diagonally or backwards.

4	2	6	4	8	2	1	8	6	1	4	4
2	5	6	0	5	8	0	6	4	8	4	8
6	2	6	2	4	9	5	6	9	0	4	9
1	0	9	8	8	8	6	8	6	1	1	7
4	1	5	1	6	6	6	0	3	8	3	6
1	1	0	1	7	3	2	2	0	8	6	5
6	2	5	5	3	7	0	1	4	8	2	3
1	1	0	3	6	1	2	9	7	1	0	1
7	8	2	5	9	4	7	7	1	1	4	8
5	1	2	9	4	7	1	0	2	8	5	1
5	0	1	2	9	6	2	4	9	4	8	1
3	2	0	1	3	5	1	9	3	8	4	7

☐ 14161	☐ 11025	☐ 1849	☐ 3025	☐ 1681
☐ 6241	☐ 841	☐ 729		

Magic Square — every row, column and diagonal adds to the same total.

	1	
	5	**7**
4		**2**

Magic constant: 15. Fill the empty cells.

Part 9 · Spot the Mistake

Each solution below reaches a wrong answer, and exactly one step is to blame. Find the first wrong step and rewrite it correctly. Marking other people's work is the fastest way to stop making their mistakes.

🔍 Spot the Mistake

Expanding ¿

Step 1. Match with $a^2-2ab+b^2$: $a=3x, b=4$.

Step 2. ¿

Step 3. ¿$9x^2-12x+16$

_____ The first wrong step is Step _____ . What should it say?

_____

🔍 Spot the Mistake

Factoring $x^2-2x-15$

Step 1. Need two numbers with sum -2 and product -15.

Step 2. Try $a=3, b=-5$: sum ¿-2, product ¿-15. ✓

Step 3. $x^2-2x-15=(x+3)(x-5)$

_____ The first wrong step is Step _____ . What should it say?

_____

🔍 Spot the Mistake

Squaring 198^2

Step 1. Write $198=200-2$.

Step 2. $200^2-2(200)(2)+2^2$

Step 3. ¿$40000-400+4=39604$

_____ The first wrong step is Step _____ . What should it say?

_____

Part 10 · Quick-Fire Round

Match each expression to its expanded or factored form

Draw a line from each item on the left to its match on the right.

#	Left	Right (shuffled)
1	¿	$(a+b)(a-b)$
2	¿	$(x-y)(x^2+xy+y^2)$
3	a^2-b^2	$(x+3)(x+4)$
4	$x^2+7x+12$	$a^2-2ab+b^2$
5	¿	$a^2+2ab+b^2$
6	x^3-y^3	¿
7	x^3+y^3	$a^3+3a^2b+3ab^2+b^3$
8	$16y^2-24y+9$	$(x+y)(x^2-xy+y^2)$

True or False Sprint

Everyone stands. Teacher reads a statement. True → stay standing. False → sit down.

#	Statement	Your call
1	¿ for all a, b.	☐ True ☐ False
2	¿ is an identity, true for every value of a and b.	☐ True ☐ False
3	$x^2-1=24$ is an identity.	☐ True ☐ False
4	¿ for all real a, b.	☐ True ☐ False
5	The middle term of ¿ is always positive.	☐ True ☐ False
6	$a^2-b^2=(a+b)(a-b)$.	☐ True ☐ False
7	$(x+a)(x+b)=x^2+(a+b)x+ab$.	☐ True ☐ False
8	To factor x^2+px+q by splitting the middle term, we need two numbers whose sum is q and product is p.	☐ True ☐ False
9	¿.	☐ True ☐ False
10	¿.	☐ True ☐ False
11	$x^3-y^3=(x-y)(x^2+xy+y^2)$.	☐ True ☐ False

#	Statement	Your call
12	¿ has three squared terms and three doubled cross terms.	☐ True ☐ False

Two Truths and a Lie

Two statements are true, one is false. Circle the lie — then correct it.

Set 1

(a) ¿.

(b) ¿.

(c) $a^2 - b^2 = (a+b)(a-b)$.

The lie is _____ . Corrected: _____

Set 2

(a) $x^2 + (a+b)x + ab = (x+a)(x+b)$.

(b) To factor $x^2 - 5x + 6$ we need two numbers with sum -5 and product 6: $-2, -3$.

(c) $x^2 - 5x + 6 = (x+2)(x+3)$.

The lie is _____ . Corrected: _____

Set 3

(a) ¿.

(b) $x^3 - y^3 = (x-y)(x^2 + xy + y^2)$.

(c) $x^3 - y^3 = (x-y)(x^2 - xy + y^2)$.

The lie is _____ . Corrected: _____

Part 11 · The Escape Challenge

Five gates, each a calculation. Each gives you one digit. Collect all five to unlock the exit code.

□ GATE 1 — The Square Gate

Find 43^2 using ¿ with $43 = 40 + 3$. Take the last digit of your answer.

Digit: □

□ GATE 2 — The Difference Gate

Find 29^2 using ¿ with $29 = 30 - 1$. Take the first digit of your answer.

Digit: □

□ GATE 3 — The Splitting Gate

Factor $x^2 + 11x + 30$ as $(x + a)(x + b)$. Take the smaller of a and b.

Digit: □

□ GATE 4 — The Cube Gate

Find the side of the cube of volume $p^3 + 6p^2q + 12pq^2 + 8q^3$ when $p = 1, q = 1$. That is, evaluate $p + 2q$.

Digit: □

□ GATE 5 — The Consecutive-Squares Gate

Take the three consecutive squares 16, 25, 36. Add the outer two and subtract twice the middle one. What do you always get?

Digit: □

EXIT CODE: □ □ □ □ □

Formula Sheet

Cut this page out and keep it. Everything in this chapter, on one page.

Square of a sum

¿

Square of a difference

¿

Square of a trinomial

¿

Difference of squares

$$a^2-b^2=(a+b)(a-b)$$

Product of two linear factors

$$(x+a)(x+b)=x^2+(a+b)x+a\,b$$

Cube of a sum

¿

Cube of a difference

¿

Difference of cubes

$$x^3-y^3=(x-y)(x^2+x\,y+y^2)$$

Sum of cubes

$$x^3+y^3=(x+y)(x^2-x\,y+y^2)$$

□ Full Solutions

Not just answers — working. Compare your method with this one; if they differ but both reach the right answer, make sure you understand why yours also works.

Part 3 · Guided Practice

1. a = 3x, b = 2; $9x^2 + 12x + 4$ · **2.** 204 = 200+4; 40000+1600+16 = 41616 · **3.** 20; 4 and 5; (x+4)(x+5) · **4.** b = 3; 3x(9)=27x, $b^3=27$; side = x+3

Practice Set A

1. ¿.

2. ¿.

3. $64=60+4$; $60^2+2(60)(4)+4^2=3600+480+16=4096$.

4. $79=80-1$; $80^2-2(80)(1)+1^2=6400-160+1=6241$.

5. ¿.

6. ¿.

7. $x^2+2x+9x+18=x^2+11x+18$.

8. Need sum 7, product 12: 3 and 4. $x^2+7x+12=(x+3)(x+4)$.

9. $41=40+1$; $40^2+2(40)(1)+1^2=1600+80+1=1681$.

10. $16y^2=$¿, $9=3^2$, middle ¿$2(4y)(3)=24y$: ¿.

Practice Set B

1. $198=200-2$; $200^2-2(200)(2)+2^2=40000-800+4=39204$.

2. $\frac{9}{5}s^2+6sv+5v^2$ — take $\frac{1}{5}$ common: $\frac{1}{5}(9s^2+30sv+25v^2)=\frac{1}{5}$¿.

3. ¿.

4. ¿.

5. Need $a+b=-11, ab=10\times(-6)=-60$: $a=-15, b=4$.
$10x^2-15x+4x-6=5x(2x-3)+2(2x-3)=(2x-3)(5x+2)$. So blanks: $(2x-3)(5x+2)$.

6. $23\times17=(20+3)(20-3)=400-9=391$.

7. Need sum -1, product -42: 6 and -7. $r^2-r-42=(r+6)(r-7)$.

8. $8n^3=$¿, $-125m^3=$¿; matches ¿ with $a=2n, b=5m$: side is $(2n-5m)$.

Practice Set C

1. Expand each square and add: ¿ (carrying out the full expansion term by term shows the actual sum is $3a^2+3b^2+3c^2-2ab-2ac...$, which does **not** simplify to

$2a^2+2b^2+2c^2$ in general) — test $a=b=c=1$: LHS ¿ $1+1+1=3$, RHS ¿ 6. Not equal, so this is **not** an identity.

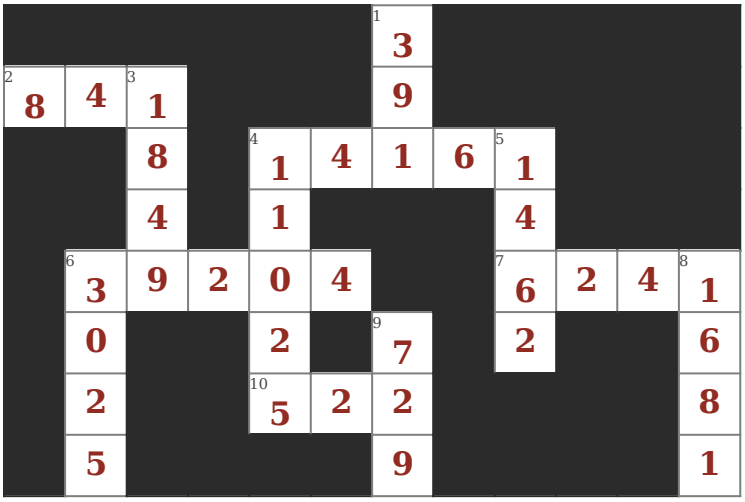
2. Square roots: $64u^2=$¿, $121v^2=$¿, $4w^2=$¿. Cross terms: $-176uv=2(8u)(-11v)$, $-32uw=2(8u)(-2w)$, $44vw=2(-11v)(-2w)$. So the three terms are $8u, -11v, -2w$: $64u^2+121v^2+4w^2-176uv-32uw+44vw=$¿.

3. James: $(a^2-2ab+b^2)(a+b)=a^3+a^2b-2a^2b-2ab^2+ab^2+b^3=a^3-a^2b-ab^2+b^3$. Reshma: $(a-b)(a^2-b^2)=a^3-ab^2-a^2b+b^3=a^3-a^2b-ab^2+b^3$. Both give the same expansion — both are correct, just different orders of grouping.

4. $27p^3-8q^3=$¿.

5. Matches ¿ with $a=p, b=2q$: edge ¿ $p+2q$. Surface area of a cube of edge s is $6s^2$, so total surface area ¿ 6 ¿.

Part 7 · Crossnumber — Solved Grid



Across: 2 = 841 · 4 = 14161 · 6 = 39204 · 7 = 6241 · 10 = 522

Down: 1 = 391 · 3 = 1849 · 4 = 11025 · 5 = 1462 · 6 = 3025 · 8 = 1681 · 9 = 729

Part 8 · Number Search — Solved Grid

4	2	6	4	8	2	**1**	**8**	**6**	**1**	4	4
2	**5**	6	0	5	8	0	6	4	8	4	8
6	**2**	6	2	4	9	5	6	9	0	4	9
1	**0**	9	8	8	8	6	8	6	1	1	7
4	**1**	5	1	6	6	**6**	0	3	8	3	6
1	**1**	0	1	7	3	2	**2**	0	8	6	5
6	2	5	5	3	7	0	1	**4**	8	2	3
1	1	0	3	6	1	2	9	7	**1**	0	1

7	8	2	**5**	9	4	7	7	1	**1**	**4**	**8**
5	1	**2**	9	4	**7**	1	0	2	8	5	1
5	**0**	1	2	9	6	**2**	4	**9**	**4**	**8**	**1**
3	2	0	1	3	5	1	**9**	3	8	4	7

Part 8 · Magic Square — Solved (constant 15)

8	**1**	**6**
3	**5**	**7**
4	**9**	**2**

Part 9 · Spot the Mistake

Problem	First wrong step	It should say
Expanding ¿	Step 1	The middle term is $2(3x)(4)=24x$, not 12x. Correct expansion: $9x^2-24x+16$.
Factoring $x^2-2x-15$	Step 1	Check by expanding: $(x+3)(x-5)=x^2-2x-15$. This one is actually correct! (Use this as the "no mistake" control — the real slip students make is picking $a=5, b=-3$, which gives the wrong middle term sign, $3x$ instead of $-2x$.)
Squaring 198^2	Step 1	$2(200)(2)=800$, not 400. Correct working: $40000-800+4=39204$.

Part 10 · Matching

#	Left	Correct match
1	¿	$a^2+2ab+b^2$
2	¿	$a^2-2ab+b^2$
3	a^2-b^2	$(a+b)(a-b)$
4	$x^2+7x+12$	$(x+3)(x+4)$

#	Left	Correct match
5	¿	$a^3+3a^2b+3ab^2+b^3$
6	x^3-y^3	$(x-y)(x^2+xy+y^2)$
7	x^3+y^3	$(x+y)(x^2-xy+y^2)$
8	$16y^2-24y+9$	¿

Part 10 · True or False

1-F · 2-T · 3-F · 4-T · 5-F · 6-T · 7-T · 8-F · 9-F · 10-T · 11-T · 12-T

Part 10 · Two Truths and a Lie

Set	The lie	Correction
1	b	The middle term of ¿ is **subtracted**: $a^2-2ab+b^2$.
2	c	With $a=-2, b=-3$ the factors are $(x-2)(x-3)$, not $(x+2)(x+3)$.
3	c	The correct factor is x^2+xy+y^2 (all plus signs) — that one is the sum-of-cubes factor pattern.

Part 11 · The Escape Challenge

EXIT CODE: 9 · 8 · 5 · 3 · 2

(Answer: 9, from 1849) (Answer: 8, from 841) (Answer: 5) (Answer: 3) (Answer: 2)

Eight identities, one big idea: a complicated expression is often a simple shape in disguise. Once you can see the square or the cube hiding inside it, the algebra does itself. □